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(54) **APPARATUS AND METHOD FOR APPLYING EFFECTS TO GRAPHICAL IMAGES**

VERFAHREN UND VORRICHTUNG ZUR ANWENDUNG VON EFFEKTEN IN GRAPHISCHEN BILDERN

SYSTEME ET PROCEDE PERMETTANT D'APPLIQUER DES EFFETS A DES IMAGES GRAPHIQUES

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(73) Proprietor: **Intergraph Hardware Technologies Company**
Las Vegas, NV 89119 (US)

(72) Inventors:
- **NETSCHKE, Gregory**
  Huntsville, AL 35803 (US)
- **CUELLAR, Gabriel**
  Huntsville, AL 35824 (US)
- **MANANA, Gabriel**
  Huntsville, AL 35816 (US)

(74) Representative: **Froud, Clive et al**
Elkington and Fife
Prospect House
8 Pembroke Road
Sevenoaks, Kent TN13 1XR (GB)

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Description

FIELD OF THE INVENTION

[0001] The invention generally relates to computer graphical production devices and, more particularly, the invention relates to applying effects to graphical images on a computer system.

BACKGROUND OF THE INVENTION

[0002] Special effects ("effects") commonly are added to graphical images in a motion picture by means of conventional graphical editing application programs such as, for example, ADOBE PREMIERE™, available from Adobe Systems Incorporated of San Jose, California. Such programs may include known effects such as, for example, zooming, rotating, and trimming. Edited motion pictures often may be previewed in a playback window on the computer system.

[0003] The functionality provided by conventional graphical editing programs, however, typically requires extensive utilization of the central processing unit and random access memory within the computer system. More particularly, the central processing unit performs all of the calculations required to apply effects to graphical images. After these calculations are completed by the central processor, the edited graphical image may be directed to a graphics accelerator for display on a display device. One such graphics accelerator is the REALIZM™ video card, available from Intergraph Corporation of Huntsville, Alabama. Such graphics accelerator utilizes the commonly known OPENGL™ application program interface (available from Silicon Graphics, Inc. of Mountain View, California) to display the edited graphical image. For more information relating to OPENGL™, see, for example, *Inside OLE*, two-dimensional. Ed., by Kraig Brockschmidt (Microsoft press 1995); *The OPENGL Technical Library*, which contains *The OPENGL Programming Guide* (ISBN: 0-201-63276-4), and *The OPENGL Reference Manual* (ISBN: 0-201-46140-4), by the OPENGL Architecture Review Board; *The OPENGL Graphics System: A Specification*, Version 1.0 et seq., by Silicon Graphics, Inc. (1992); *Microsoft OPENGL Installable Client Driver Specification*, Microsoft Corporation; *Computer Graphics Principles and Practice*, by Foley van Dam (Addison-Wesley 1996); *OPENGL Programming Guide*, (ISBN; 0-201-46138-2), by the OPENGL Architecture Review Board. These related documents are incorporated herein, in their entireties, by reference.

[0004] US 5,592,602 describes a multimedia effect tool in which effects are applied to objects. The calculations are carried out in a computer system having a processor, memory, and storage, in particular in the processor.

[0005] Utilizing the central processing unit for performing such calculations, however, undesirably slows computer system performance. The art has responded to this problem by providing one or more dedicated co-processors for performing the necessary calculations. Although typically more efficient than utilizing the central processing unit, co-processors are expensive, thus increasing the cost of editing graphical images with such graphical image editing programs. Moreover, co-processors typically are difficult to program.

SUMMARY OF THE INVENTION

[0006] The invention is defined by the appended claims.

[0007] In accordance with one aspect of the invention, an apparatus and method of applying an effect to graphical data utilizes a graphics processor to apply the effect to a graphical image having the graphical data. The computer system includes a central processing unit, in addition to the graphics processor. To that end, the graphics processor is configured to process graphical data in accordance with a preselected graphics processing format as set out in claims 1, 14 and 27. The effect and graphical image are defined and converted, respectively, into the preselected graphics processing format. In accordance with preferred embodiments of the invention, the graphics processor is controlled to apply the effect to the graphical image to produce an output graphical image. The output graphical image includes both the effect and the graphical image. In preferred embodiments, the graphics processor is a graphics accelerator card, and the graphics processing format is OPENGL™.

[0008] In accordance with embodiments of the invention, the effect may be applied to the graphical image so that the effect is normalized with respect to he graphical image. Specifically, the effect may be applied to the graphical image as a ratio of the size of the graphical image. Moreover, the output graphical image may be stored in volatile or non-volatile memory in the computer system as a frame or other type of graphical image. Alternatively, the effect may be applied to the graphical image within texture memory that is a part of the graphics processor. The texture may be the graphics processor format for the input image.

[0009] In yet other embodiments, the effect may include an initial effect and a final effect. In preferred embodiments, the effect may be applied to the graphical image by interpolating between the initial effect and the final effect to provide a continuous effect. The graphical image may be any known graphical image that may be converted into computer readable form. For example, the graphical image may be a video image having a plurality of fields, or a motion picture having a plurality of frames.

[0010] Preferred embodiments of the invention are implemented as a computer program product having a computer usable medium with computer readable program code thereon. The computer readable code may

be read and utilized by the computer system in accordance with conventional processes.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The foregoing and other objects and advantages of the invention will be appreciated more fully from the following further description thereof with reference to the accompanying drawings wherein:

Figure 1 schematically shows an exemplary computer system that may be utilized with a preferred embodiment of the invention.

Figure 2 shows a process of applying special effects to a graphical image in accordance with a preferred embodiment of the invention.

Figure 3 shows a graphical user interface that may be utilized to apply effects to a graphical image in accordance with a preferred embodiment of the invention.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

[0012] In accordance with preferred embodiments of the invention, a graphics accelerator configured for use with the OPENGL™ application program interface (a/k/a OPENGL™ format) applies an effect that is in the OPENGL™ format to a graphical image that also is in the OPENGL™ format. Details of preferred and other embodiments are discussed below.

[0013] Figure 1 illustrates the system architecture for an exemplary computer system 100, such as an Intergraph model number TDZ2000 computer system (available from Intergraph Corporation of Huntsville, Alabama), on which the disclosed method and apparatus for applying effects to graphical data can be implemented. The exemplary computer system of Figure 1 is discussed for descriptive purposes only, however, and should not be considered a limitation of the invention. Although the description below may refer to terms commonly used in describing particular computer systems, the described concepts apply equally to other computer systems, including systems having architectures that are dissimilar to that shown in Figure 1.

[0014] The computer 100 includes a central processing unit (CPU) 105 having a conventional microprocessor, random access memory (RAM) 110 for temporary storage of information, and read only memory (ROM) 115 for permanent storage of read only information. A memory controller 100 is provided for controlling system RAM 110. A bus controller 125 is provided for controlling a bus 130, and an interrupt controller 135 is provided for receiving and processing various interrupt signals from the other system components.

[0015] Mass storage may be provided by known non-volatile storage media, such as a diskette 142, a digital versatile disk (not shown), a CD-ROM 147, or a hard disk 152. Data and software may be exchanged with the computer system 100 via removable media, such as the diskette 142 and the CD-ROM 147. The diskette 142 is insertable into a diskette drive 141, which utilizes a diskette drive controller 140 to interface with the bus 130. Similarly, the CD-ROM 147 is insertable into a CD-ROM drive 146, which utilizes a CD-ROM drive controller 145 to interface with the bus 130. Finally, the hard disk 152 is part of a fixed disk drive 151, which utilizes a hard drive controller 150 to interface with the bus 130.

[0016] User input to the computer 100 may be provided by a number of devices. For example, a keyboard 156 and a mouse 157 may be connected to the bus 330 by a keyboard and mouse controller 155. An audio transducer 196, which may act as both a microphone and a speaker, is connected to the bus 130 by audio controller 197. It should be obvious to those reasonably skilled in the art that other input devices, such as a pen and/or tablet and a microphone for voice input, may be connected to computer 100 through bus 130 and an appropriate controller. A direct memory access (DMA) controller 160 is provided for performing direct memory access to system RAM 110. A visual display may be generated by a video controller 165, which controls a graphics accelerator 167 and a display device 170. In preferred embodiments, the graphics accelerator is a REALIZM™ video card, available from Intergraph Corporation of Huntsville, Alabama. As is known in the art, the REALIZM™ video card is configured for use with the OPENGL™ application program interface ("API") for rendering three dimensional ("3D") images on the display device 170.

[0017] A network adapter 190 also may be included to enable the computer system 100 to be interconnected to a network 195 via a network bus 191. The network 195, which may be a local area network (LAN), a wide area network (WAN), or the Internet, may utilize general purpose communication lines that interconnect a plurality of network devices.

[0018] The computer system 100 preferably is controlled and coordinated by operating system software, such as the WINDOWS NT® operating system (available from Microsoft Corp., of Redmond, Washington). Among other computer system control functions, the operating system controls allocation of system resources and performs tasks such as process scheduling, memory management, networking, and I/O services. As suggested above, the operating system preferably includes an OPENGL™ application program interface for rendering non-trivial 3D graphical indicia on the display device 170.

[0019] Figure 2 shows a process of applying special effects to a graphical image in accordance with a preferred embodiment of the invention. The process begins at step 200 in which a set of effects is defined in accord with the OPENGL™ format, and then stored in the non-volatile memory 152. These effects may include unique effects created by a programmer, or commonly known

effects. Some commonly known effects include geometry transformations that change the shapes of images without changing the image colors, (e.g., "BUMP", "CROP", "DEFORM", and "ROTATE"), "BALLOON", and "SHINES." Additional known effects may include "CONCENTRIC BLINDS", "DISPLACEMENT", "RADAR BLINDS", "TOKYO BLINDS" and "VENETIAN BLINDS."

[0020] In preferred embodiments, effects may be edited and/or combined with other effects to produce yet additional effects. An effect preferably is defined by first developing a prototype of the effect. Such prototype preferably includes a program written in any known programming language (*e.g.*, the C++ programming language) utilizing the OPENGL™ API and WINDOWS NT™ API. In preferred embodiments, effects are designed to manipulate the 3D geometry of graphical images and their applied textures in OPENGL™ to obtain a desired output image result. Once satisfactorily developed, the (effect) program is configured to interface with the particular application program with which it is to be utilized.

[0021] The process then continues to step 202 in which a graphical image to be manipulated is obtained from memory. The image may be read from a file or generated from graphical software. The formatting data for the graphical image can comply with any graphical format and thus, does not necessarily comply with the OPENGL™ API. For example, the graphical image may be a video image from a live feed (*i.e.*, having fields and requiring field rendering), a frame or plurality of frames in a motion picture (*e.g.*, an .avi file stored on disk), a bitmap file, or a graphic image file (*i.e.*, a .gif file). Such images may be mapped representations on a two-dimensional medium (*i.e.*, the display device).

[0022] Once the image is obtained, a 3D view area is set up in accord with conventional processes (step 204) and then the graphical image is moved into texture memory on the graphics accelerator (step 206). The following OPENGL™ functions may be used to move the image into texture memory:

- glTexEnvi;
- glTexParameteri;
- glEnable; and
- glTeximage2D.

[0023] The image then is defined in a 3D geometry and the texture is applied to it to produce an affected output image (step 208). More particularly, the geometry of the image is manipulated by the application of the texture by the OPENGL™ graphical accelerator 167 to produce the affected output image in 3D. The shape of the 3D image being manipulated, its alignment relative to the view volume, and the manner of mapping the texture to the 3D geometry determine the content of the affected output image. Of course, the calculations for applying the effect to the converted graphical image are performed by the graphical accelerator 167 and not by the central processing unit 105. The OPENGL™ functions that may be utilized for step 208 include:

- glBegin;
- glTexCoord3d;
- glVertex2d or glVenex3d;
- glEnd;
- glEnable; and
- glDisable.

[0024] It then is determined at step 210 if effects are to be applied to additional images and combined with the output image from step 208. The positioning of the different affected 3D output images relative to one another in the view volume determines the interaction between images. The process loops to step 206 if effects are to be applied to additional images. If not, then the process moves to step 212 in which the image is displayed via a frame buffer capture operation. More particularly, the output image preferably is written to a frame buffer and consequently, displayed on the display device 170. An immediate display of this type is preferable, for example, to preview the application of an effect in an editing process. In some embodiments, however, such as those that do not require a preview, the OPENGL™ capture of the output image from the frame buffer is performed in a hidden window. More particularly, the window attributes may be set so that the output image will not be displayed on the display device 170. In other embodiments in which the OPENGL™ API is not utilized, a hidden window may not be necessary. The OPENGL functions that may be used for step 212 include:

- glFlush;
- glReadBuffer; and
- glReadPixels.

[0025] In preferred embodiments of the invention, effects are normalized to be applied to a converted graphical image as a ratio of the size of the converted graphical image. Specifically, rather than specifying an effect with respect to a measurement of the image (*e.g.*, inches or pixels), the effect may be specified as a percentage of the size of the image. For example, for a well known "SPHERIZE" effect, the center of the converted image first may be determined and the effect may process twenty percent of the image extending radially from such center location. Accordingly, preferred embodiments of the invention may apply effects to images having different sizes and still provide consistent output images.

[0026] Multiple effects may be applied to a single graphical image. Most graphical accelerators, however, have a maximum texture size that can be applied to an image. Accordingly, multiple textures for an input image may be mapped into an array associated with the graphical image.

[0027] Effects also may be applied to large images requiring a significant amount of memory by utilizing tiling techniques. More particularly, an input image may be divided (*i.e.*, tiled) into two or more separate images that each are sized to be within the memory constraints of the computer system 100. Once tiled, the effects may be applied to each tile so that when the image is reassembled, the effect is applied to the entire image in a unitary manner. Only the portion of the effect that would be applied to a particular section of the overall image (*i.e.*, within a tile) is applied to an individual tile. For example, if a swirl effect is applied to a large source image, such image may be broken up into four separate tiles (*i.e.*, quadrants). The tiles are arrayed on a 3D geometry such that when the 3D geometry is swirled, the swirl appears to be a single swirl that was applied to the overall image. The boundaries between each of the tiles preferably are imperceptible by utilizing conventional anti-aliasing techniques.

[0028] Tiling techniques also may be utilized to reduce the resolution of a high resolution graphical image that is to be displayed on a lower resolution display device. To that end, the input graphical image may be tiled in accord with the resolution of the display device, and then reassembled for display.

[0029] As noted above, effects may be applied to a series of frames in a motion picture. For example, a "ROTATE" effect may rotate a three-dimensional graphical image in a three-dimensional space. In preferred embodiments, a starting position of the graphical image and an ending position of the graphical image (in the three-dimensional space) may be pre-set without any provision as to the positions of the image between such starting and ending position. To that end, in addition to applying the effect to the starting and ending frames, preferred embodiments of the invention calculate incremental effect changes and accordingly apply the effect to the intermediate frames in the motion picture. Assuming the graphical image is a cube, for example, preferred embodiments of the invention may determine the location of the cube in each intermediate frame of the motion picture between the starting and ending positions. Additional attributes of such intermediate frames such as, for example, shading and light reflections, also are calculated and applied to provide a higher quality display.

[0030] Figure 3 shows a graphical user interface ("interface 300") that may be utilized to apply effects to a graphical image in accordance with a preferred embodiment of the invention. To that end, the interface 300 includes an Input/Output page 302 for setting system parameters, and a viewing area 304 showing the effect, input image, and output image. More particularly, the Input/Output page 302 includes a plurality of fields that may be configured by a user editing an input graphical image. Each of those fields is discussed below.

[0031] A buffer field 306 indicates the buffer from which the input graphical image is to be received. Each output image also may be configured to be input for application of additional effects. The buffer field 306 includes a radio button 308 that activates the field 306. In preferred embodiments, the buffer field 306 has a default buffer that operates like a stack.

[0032] A file field 310 indicates the file from which to import the graphical image. In a manner similar to the buffer field 306 , the file field 310 also includes a radio button 312 that activates the field 310. A file name may be written directly into this field 310, or a plurality of other files may be browsed via a browse button 313 for selection into this field 310.

[0033] An output field 314 indicates where the output image is to be displayed and/or stored. In particular, the output image may be displayed on the screen, or saved to either of the default buffer or a buffer selected by the user.

[0034] The interface 300 also includes a preview area 315 having three windows. Specifically, the preview area 315 includes an input window 316 for displaying the input graphical image, a parameter window 318 to preview and edit the output image (and effect) prior to saving in non-volatile memory, and an output window 320 to display the output image that is to be saved in non-volatile memory 152. The interface 300 also includes a tool bar 322 that may be utilized to edit the effect in the parameter window 318. The tool bar 322 operates in accordance with conventional processes. The parameter window 318 also includes a timeline controller 324 that enables a user to move along a number of frames in an effect. The timeline controller 324 is configured to operate in a manner similar to controls of a tape recorder.

[0035] In an alternative embodiment, the disclosed apparatus and method for applying effects to graphical images may be implemented as a computer program product for use with a computer system. Such implementation may include a series of computer instructions fixed either on a tangible medium, such as a computer readable media (*e.g.*, a diskette, CD-ROM, ROM, or fixed disk) or transmittable to a computer system, via a modem or other interface device, such as a communications adapter connected to a network over a medium. Medium may be either a tangible medium (*e.g.*, optical or analog communications lines) or a medium implemented with wireless techniques (*e.g.*, microwave, infrared or other transmission techniques). The series of computer instructions embodies all or part of the functionality previously described herein with respect to the system. Those skilled in the art should appreciate that such computer instructions can be written in a number of programming languages for use with many computer architectures or operating systems. Furthermore, such instructions may be stored in any memory device, such as semiconductor, magnetic, optical or other memory devices, and may be transmitted using any communications technology, such as optical, infrared, microwave, or other transmission technologies. It is expected that such a computer program product may be distributed as a removable media with accompanying printed or elec-

tronic documentation (*e.g.*, shrink wrapped software), preloaded with a computer system (*e.g.*, on system ROM or fixed disk), or distributed from a server or electronic bulletin board over the network (e.g., the Internet or World Wide Web).

[0036] It should be noted that although preferred embodiments of the invention have been discussed as using the OPENGL™ format, it is contemplated that other three dimensional graphical formats may be utilized to apply effects to input images. For example, a graphics accelerator configured for use with the well known DIRECT3D™ graphical display API (available from Microsoft Corp.) may be used for such purposes. Accordingly, discussion of the OPENGL™ format is not intended to limit the scope of the invention.

Claims

1. A computer program product for use on a computer system for applying effects to graphical data on a computer system, the computer system having a central processing unit (105) and a graphics processor that is preconfigured to process graphical data in accordance with a preselected 3D graphics processing format, the computer program product comprising a computer usable medium having computer readable program code thereon, the computer readable program code including:

   program code for receiving (202) an input image, the input image being a 2D representation of a 3D object;
   program code for defining (200) an effect in the preselected 3D graphics processing format;
   program code for mapping (206) the input image into the preselected 3D graphics processing format to produce a mapped image;
   program code for controlling (208) the graphics processor (167) to apply the effect to the mapped image to produce an output graphical image, the output graphical image being the result of the application of the effect to the mapped image, application of the effect manipulating the 3D geometry of the mapped image and any textures associated with the mapped image; and
   program code for converting (212) the output graphical image into a 2D representation of the 3D object for display on the display device, whereby said converted output image is the result of image processing applied to said input image via 3D graphics processing.

2. The computer program product as defined by claim 1 wherein the graphics processor (167) is a graphics accelerator card.

3. The computer program product as defined by claim 1 wherein the preselected graphics processing format is OPENGL™.

4. The computer program product as defined by claim 1 wherein the program code for controlling comprises:

   program code for normalizing the effect with respect to the input image.

5. The computer program product as defined by claim I wherein the input image has a size, the program code for controlling comprising:

   program code for applying the effect to the input image as a ratio of the size of the input image.

6. The computer program product as defined by claim 1 wherein the computer system includes memory, the computer program product further comprising:

   program code for storing the output graphical image in memory.

7. The computer program product as defined by claim 1 wherein the graphical image is a frame.

8. The computer program product as defined by claim 1 wherein the graphics processor (167) includes resident texture memory, the program code for mapping comprising:

   program code for storing the mapping image in the resident texture memory.

9. The computer program product as defined by claim 1 wherein the effect is defined as the rendering of a view of a textured 3D object.

10. The computer program product as defined by claim 1 wherein the program code for defining comprises:

    program code for defining an initial effect and a final effect.

11. The computer program product as defined by claim 10 wherein the program code for controlling comprises:

    program code for interpolating between the initial effect and the final effect to render a plurality of output graphical images.

12. The computer program product as defined by claim 1 wherein the input image comprises fields.

13. The computer program product as defined by claim

1 wherein the input image is a plurality of frames in a motion picture.

14. An apparatus for applying effects to graphical data on a computer system, the computer system having a central processing unit (105) and a graphics processor (167) that is preconfigured to process graphical data in accordance with a preselected 3D graphics processing format, the apparatus comprising:

means for receiving an input image, the input image being a 2D representation of a 3D object;
means for defining an effect in the preselected 3D graphics processing format;
means for mapping the input image into the preselected 3D graphics processing format to produce a mapped image;
means for controlling the graphics processor (167) to apply the effect to the mapped image to produce an output graphical image, the output graphical image being the result of the application of the effect to the mapped image, application of the effect manipulating the 3D geometry of the mapped image and any textures associated with the mapped image; and
means for converting the output graphical image into a 2D representation of the 3D object for display on the display device, whereby said converted output image is the result of image processing applied to said input image via 3D graphics processing.

15. The apparatus as defined by claim 14 wherein the graphics processor (167) is a graphics accelerator card.

16. The apparatus as defined by claim 14 wherein the preselected graphics processing format is OPENGL™.

17. The apparatus as defined by claim 14 wherein the means for controlling comprises the step of:

means for normalizing the effect with respect to the input image.

18. The apparatus as defined by claim 14 wherein the input image has a size, the means for controlling comprising:

means for applying the effect to the input image as a ratio of the size of the input . image.

19. The apparatus as defined by claim 14 wherein the computer system includes memory, the apparatus further comprising:

means for storing the output graphical image in memory.

20. The apparatus as defined by claim 14 wherein the graphical image is a frame.

21. The apparatus as defined by claim 14 wherein the graphics processor (167) includes resident texture memory, the means for mapping comprising:

means for storing the mapped image in the resident texture memory.

22. The apparatus as defined by claim 14 wherein the effect is defined as the rendering of a view of a textured 3D object.

23. The apparatus as defined by claim 14 wherein the means for defining comprises:

means for defining an initial effect and a final effect.

24. The apparatus as defined by claim 23 wherein the means for controlling comprises:

means for interpolating between the initial effect and the final effect to render a plurality of output graphical images.

25. The apparatus as defined by claim 14 wherein the input image comprises fields.

26. The apparatus as defined by claim 14 wherein the input image is a plurality of frames in a motion picture.

27. A method of applying effects to graphical data on a computer system, the computer system having central processing unit (105) and a graphics processor (167) that is preconfigured to process graphical data in accordance with a preselected 3D graphics processing format, the method comprising the steps of:

A. receiving (202) an input image, the input image being a 2D representation of a 3D object;
B. defining (200) an effect in the preselected 3D graphics processing format;
C. mapping (206) the input image into the preselected 3D graphics processing format to produce a mapped image;
D. controlling (208) the graphics processor to apply the effect to the mapped image to produce an output graphical image, the output graphical image being the result of the application of the effect to the mapped image, application of the effect manipulating the 3D geometry

of the mapped image and any textures associated with the mapped image; and
E. converting (212) the output graphical image into a 2D representation of the 3D object for display on the display device, whereby said converted output image is the result of image processing applied to said input image via 3D graphics processing.

28. The method as defined by claim 27 wherein the graphics processor (167) is a graphics accelerator card.

29. The method as defined by claim 27 wherein the preselected graphics processing format is OPENGL™.

30. The method as defined by claim 27 wherein the computer system includes a central processing unit (105).

31. The method as defined by claim 27 where in step D comprises the step of:

D1. normalizing the effect with respect to the input image.

32. The method as defined by claim 27 wherein the input image has a size, step D comprising the step of:

D2. applying the effect to the input image as a ratio of the size of the input image.

33. The method as defined by claim 27 wherein the computer system includes memory, the method further comprising the step of:

F. storing the output graphical image in memory.

34. The method as defined by claim 27 wherein the graphical image is a frame.

35. The method as defined by claim 27 wherein the graphics processor (167) includes resident texture memory, step C comprising the step of:

C1. storing the mapped image in the resident texture memory.

36. The method as defined by claim 27 wherein the effect is defined as the rendering of a view of a textured 3D object.

37. The method as defined by claim 27 wherein step B comprises the step of:

B1. defining an initial effect and a final effect.

38. The method as defined by claim 37 wherein step D comprises the step of:

D3. interpolating between the initial effect and the final effect to render a plurality of output graphical images.

39. The method as defined by claim 27 wherein the input image comprises fields.

40. The method as defined by claim 27 wherein the input image is a plurality of frames in a motion picture.

Patentansprüche

1. Computerprogrammprodukt zur Verwendung auf einem Computersystem zur Anwendung von Effekten auf graphische Daten auf einem Computersystem, wobei das Computersystem eine Zentralverarbeitungseinheit (105) und einen Graphikprozessor aufweist, der vorkonfiguriert ist, um graphische Daten gemäß einem gewählten 3D-Graphikverarbeitungsformat zu verarbeiten, wobei das Computerprogrammprodukt ein computernutzbares Medium umfasst, das einen computerlesbaren Programmkode darauf aufweist, wobei der computerlesbare Programmkode beinhaltet:

Programmkode zum Empfangen (202) eines Eingangsbildes, wobei das Eingangsbild eine 2D-Darstellung eines 3D-Objekts ist;
Programmkode zum Definieren (200) eines Effekts im gewählten 3D-Graphikverarbeitungsformat;
Programmkode zum Abbilden (206) des Eingangsbildes im gewählten 3D-Graphikverarbeitungsformat, um ein abgebildetes Bild zu erzeugen;
Programmkode zum Steuern (208) des Graphikprozessors (167), um den Effekt auf das abgebildete Bild aufzubringen, um ein graphisches Ausgabebild zu erzeugen, wobei das graphische Ausgabebild das Ergebnis ist der Anwendung des Effekts auf das abgebildete Bild, Anwendung des Effekts zum Manipulieren der 3D-Geometrie des abgebildeten Bildes und jeglicher Texturen, die dem abgebildeten Bild zugeordnet sind; und
Programmkode zum Konvertieren (212) des graphischen Ausgabebildes in eine 2D-Darstellung des 3D-Objekts zur Anzeige auf der Anzeigevorrichtung, wodurch das konvertierte Ausgabebild das Ergebnis der Bildverarbeitung ist, die auf das Eingabebild über 3D-Graphikverarbeitung angewendet ist.

2. Computerprogrammprodukt wie in Anspruch 1 de-

finiert, worin der Graphikprozessor (167) eine Graphikbeschleunigerkarte ist.

3. Computerprogrammprodukt wie in Anspruch 1 definiert, worin das gewählte Graphikverarbeitungsformat OPENGL™ ist.

4. Computerprogrammprodukt wie in Anspruch 1 definiert, worin der Programmkode zur Steuerung umfasst:

   Programmkode zum Normalisieren des Effekts in Bezug auf das Eingangsbild.

5. Computerprogrammprodukt wie in Anspruch 1 definiert, worin das Eingangsbild eine Größe aufweist, wobei der Programmkode zur Steuerung umfasst:

   Programmkode zum Anwenden des Effekts auf das Eingangsbild als Größenverhältnis des Eingangsbildes.

6. Computerprogrammprodukt wie in Anspruch 1 definiert, worin das Computersystem Speicher aufweist, wobei das Computerprogrammprodukt ferner umfasst:

   Programmkode zum Speichern des graphischen Ausgabebildes im Speicher.

7. Computerprogrammprodukt wie in Anspruch 1 definiert, worin das graphische Bild ein Vollbild (Frame) ist.

8. Computerprogrammprodukt wie in Anspruch 1 definiert, worin der Graphikprozessor (167) residente Texturspeicher aufweist, wobei der Programmkode zum Abbilden umfasst:

   Programmkode zum Speichern des abgebildeten Bildes im residenten Texturspeicher.

9. Computerprogrammprodukt wie in Anspruch 1 definiert, worin der Effekt als Bildaufbereitung einer Ansicht eines texturierten 3D-Objekts definiert ist.

10. Computerprogrammprodukt wie in Anspruch 1 definiert, worin der Programmkode zum Definieren umfasst:

    Programmkode zum Definieren eines Anfangseffekts und eines Endeffekts.

11. Computerprogrammprodukt wie in Anspruch 10 definiert, worin der Programmkode zum Steuern umfasst:

    Programmkode zum Interpolieren zwischen dem Anfangseffekt und dem Endeffekt, so dass eine Vielzahl von graphischen Ausgabebildern bearbeitet wird.

12. Computerprogrammprodukt wie in Anspruch 1 definiert, worin das Eingangsbild Felder umfasst.

13. Computerprogrammprodukt wie in Anspruch 1 definiert, worin das Eingangsbild eine Vielzahl von Vollbildern in einer kinematographischen Aufnahme ist.

14. Vorrichtung zur Anwendung von Effekten auf graphische Daten auf einem Computersystem, wobei das Computersystem eine Zentralverarbeitungseinheit (105) und einen Graphikprozessor (167) aufweist, der vorkonfiguriert ist, um graphische Daten gemäß einem gewählten 3D-Graphikverarbeitungsformat zu verarbeiten, wobei die Vorrichtung umfasst:

    Mittel zum Empfangen eines Eingangsbildes, wobei das Eingangsbild eine 2D-Darstellung eines 3D-Objekts ist;
    Mittel zum Definieren eines Effekts im gewählten 3D-Graphikverarbeitungsformat;
    Mittel zum Abbilden des Eingangsbildes im gewählten 3D-Graphikverarbeitungsformat, um ein abgebildetes Bild zu erzeugen;
    Mittel zum Steuern des Graphikprozessors (167), um den Effekt auf das abgebildete Bild aufzubringen, um ein graphisches Ausgabebild zu erzeugen, wobei das graphische Ausgabebild das Ergebnis ist der Anwendung des Effekts auf das abgebildete Bild, Anwendung des Effekts zum Manipulieren der 3D-Geometrie des abgebildeten Bildes und jeglicher Texturen, die dem abgebildeten Bild zugeordnet sind; und
    Mittel zum Konvertieren des graphischen Ausgabebildes in eine 2D-Darstellung des 3D-Objekts zur Anzeige auf der Anzeigevorrichtung,

    wodurch das konvertierte Ausgabebild das Ergebnis der Bildverarbeitung ist, die auf das Eingabebild über 3D-Graphikverarbeitung angewendet ist.

15. Vorrichtung wie in Anspruch 14 definiert, worin der Graphikprozessor (167) eine Graphikbeschleunigerkarte ist.

16. Vorrichtung wie in Anspruch 14 definiert, worin das gewählte Graphikverarbeitungsformat OPENGL™ ist.

17. Vorrichtung wie in Anspruch 14 definiert, worin die Mittel zum Steuern den Schritt umfassen:

Mittel zum Normalisieren des Effekts in Bezug auf das Eingangsbild.

18. Vorrichtung wie in Anspruch 14 definiert, worin das Eingangsbild eine Größe aufweist, wobei die Mittel zum Steuern umfassen:

Mittel zum Anwenden des Effekts auf das Eingangsbild als Größenverhältnis des Eingangsbildes.

19. Vorrichtung wie in Anspruch 14 definiert, worin das Computersystem Speicher aufweist, wobei die Vorrichtung ferner umfasst:

Mittel zum Speichern des graphischen Ausgabebildes im Speicher.

20. Vorrichtung wie in Anspruch 14 definiert, worin das graphische Bild ein Vollbild ist.

21. Vorrichtung wie in Anspruch 14 definiert, worin der Graphikprozessor (167) residente Texturspeicher aufweist, wobei die Mittel zum Abbilden umfassen:

Mittel zum Speichern des abgebildeten Bildes im residenten Texturspeicher.

22. Vorrichtung wie in Anspruch 14 definiert, worin der Effekt als Bildaufbereitung einer Ansicht eines texturierten 3D-Objekts definiert ist.

23. Vorrichtung wie in Anspruch 14 definiert, worin die Mittel zum Definieren umfassen:

Mittel zum Definieren eines Anfangseffekts und eines Endeffekts.

24. Vorrichtung wie in Anspruch 23 definiert, worin die Mittel zum Steuern umfassen:

Mittel zum Interpolieren zwischen dem Anfangseffekt und dem Endeffekt, so dass eine Vielzahl von graphischen Ausgabebildern bearbeitet wird.

25. Vorrichtung wie in Anspruch 14 definiert, worin das Eingangsbild Felder umfasst.

26. Vorrichtung wie in Anspruch 14 definiert, worin das Eingangsbild eine Vielzahl von Vollbildern in einer kinematographischen Aufnahme ist.

27. Verfahren zur Anwendung von Effekten auf graphische Daten auf einem Computersystem, wobei das Computersystem eine Zentralverarbeitungseinheit (105) und einen Graphikprozessor (167) aufweist, der vorkonfiguriert ist, um graphische Daten gemäß einem gewählten 3D-Graphikverarbeitungsformat zu verarbeiten, wobei das Verfahren die Schritte umfasst:

A. Empfangen (202) eines Eingangsbildes, wobei das Eingangsbild eine 2D-Darstellung eines 3D-Objekts ist;
B. Definieren (200) eines Effekts im gewählten 3D-Graphikverarbeitungsformat;
C. Abbilden (206) des Eingangsbildes im gewählten 3D-Graphikverarbeitungsformat, um ein abgebildetes Bild zu erzeugen;
D. Steuern (208) des Graphikprozessors (167), um den Effekt auf das abgebildete Bild aufzubringen, um ein graphisches Ausgabebild zu erzeugen, wobei das graphische Ausgabebild das Ergebnis ist der Anwendung des Effekts auf das abgebildete Bild, Anwendung des Effekts zum Manipulieren der 3D-Geometrie des abgebildeten Bildes und jeglicher Texturen, die dem abgebildeten Bild zugeordnet sind; und
E. Konvertieren (212) des graphischen Ausgabebildes in eine 2D-Darstellung des 3D-Objekts zur Anzeige auf der Anzeigevorrichtung,

wodurch das konvertierte Ausgabebild das Ergebnis der Bildverarbeitung ist, die auf das Eingabebild über 3D-Graphikverarbeitung angewendet wird.

28. Verfahren wie in Anspruch 27 definiert, worin der Graphikprozessor (167) eine Graphikbeschleunigerkarte ist.

29. Verfahren wie in Anspruch 27 definiert, worin das gewählte Graphikverarbeitungsformat OPENGL™ ist.

30. Verfahren wie in Anspruch 27 definiert, worin das Computersystem eine Zentralverarbeitungseinheit (105) umfasst.

31. Verfahren wie in Anspruch 27 definiert, worin Schritt D den Schritt umfasst:

D1. Normalisieren des Effekts in Bezug auf das Eingangsbild.

32. Verfahren wie in Anspruch 27 definiert, worin das Eingangsbild eine Größe aufweist, wobei Schritt D den Schritt umfasst:

D2. Anwendung des Effekts auf das Eingangsbild als Größenverhältnis des Eingangsbildes.

33. Verfahren wie in Anspruch 27 definiert, worin das Computersystem Speicher umfasst, wobei das Verfahren ferner den Schritt umfasst:

F. Speichern des graphischen Ausgabebildes im Speicher.

34. Verfahren wie in Anspruch 27 definiert, worin das graphische Bild ein Vollbild ist.

35. Verfahren wie in Anspruch 27 definiert, worin der Graphikprozessor (167) residenten Texturspeicher aufweist, wobei Schritt C den Schritt umfasst:

C1. Speichern das abgebildeten Bildes im residenten Texturspeicher.

36. Verfahren wie in Anspruch 27 definiert, worin der Effekt als Bildaufbereitung einer Ansicht eines texturierten 3D-Objekts definiert ist.

37. Verfahren wie in Anspruch 27 definiert, worin Schritt B den Schritt umfasst:

B1. Definieren eines Anfangseffekts und eines Endeffekts.

38. Verfahren wie in Anspruch 37 definiert, worin Schritt D den Schritt umfasst:

D3. Interpolieren zwischen dem Anfangseffekt und dem Endeffekt, so dass eine Vielzahl von graphischen Ausgabebildern bearbeitet wird.

39. Verfahren wie in Anspruch 27 definiert, worin das Eingangsbild Felder umfasst.

40. Verfahren wie in Anspruch 27 definiert, worin das Eingangsbild eine Vielzahl von Vollbildern in einer kinematographischen Aufnahme ist.

Revendications

1. Produit support de programme pour ordinateur pour l'utilisation dans un système informatique pour appliquer des effets à des données graphiques dans un système informatique, le système informatique comportant une unité centrale de traitement (105) et un processeur graphique (167) qui est configuré au préalable pour traiter des données graphiques conformes à un format présélectionné de traitement graphique en 3 D, le Produit support de programme pour ordinateur comprenant un support utilisable par un ordinateur sur lequel est écrit un code de programme qui peut être lu par un ordinateur, le code de programme qui peut être lu par un ordinateur comprenant :

un code de programme pour recevoir (202) une image d'entrée, l'image d'entrée étant une représentation en 2 D d'un objet en 3 D ;

un code de programme pour définir (200) un effet dans le format présélectionné de traitement graphique en 3 D ;

un code de programme pour cartographier l'image d'entrée dans le format présélectionné de traitement graphique en 3 D pour produire une image cartographiée ;

un code de programme pour commander (208) pour appliquer l'effet à l'image cartographiée pour produire une image graphique de sortie, l'image graphique de sortie étant le résultat de l'application de l'effet à l'image cartographiée, l'application de l'effet agissant sur la géométrie en 3 D de l'image cartographiée et des textures quelconques associées à l'image cartographiée ; et

un code de programme pour convertir (212) l'image graphique de sortie en une représentation en 2 D de l'objet en 3 D pour l'affichage sur un dispositif d'affichage, ladite image de sortie transformée étant le résultat du traitement d'image qui a été appliqué à ladite image d'entrée par l'intermédiaire du traitement graphique 3 D.

2. Produit support de programme pour ordinateur tel que défini par la revendication 1, dans lequel le processeur graphique (167) est une carte d'accélérateur graphique.

3. Produit support de programme pour ordinateur tel que défini par la revendication 1, dans lequel le format présélectionné de traitement graphique est OPENGL (marque déposée).

4. Produit support de programme pour ordinateur tel que défini par la revendication 1, dans lequel le code de programme de commande (208) comprend :

un code de programme pour normaliser l'effet par rapport à l'image d'entrée.

5. Produit support de programme pour ordinateur tel que défini par la revendication 1, dans lequel l'image d'entrée a une taille, les moyens de commande (208) comprenant :

un code de programme pour appliquer l'effet à l'image d'entrée en tant que rapport de la taille de l'image d'entrée.

6. Produit support de programme pour ordinateur tel que défini par la revendication 1, dans lequel le système informatique comprend une mémoire, le Produit support de programme pour ordinateur comprenant en outre :

un code de programme pour enregistrer l'ima-

ge graphique de sortie dans la mémoire.

7. Produit support de programme pour ordinateur tel que défini par la revendication 1, dans lequel l'image graphique est une trame.

8. Produit support de programme pour ordinateur tel que défini par la revendication 1, dans lequel le processeur graphique (167) comprend une mémoire de texture résidente, le code de programme de cartographie comprenant :

un code de programme pour enregistrer l'image de cartographie dans la mémoire de texture résidente.

9. Produit support de programme pour ordinateur tel que défini par la revendication 1, dans lequel l'effet est défini pour restituer une vue d'un objet texturé en 3 D.

10. Produit support de programme pour ordinateur tel que défini par la revendication 1, dans lequel le code de programme de définition comprend :

un code de programme pour définir un effet initial et un effet final.

11. Produit support de programme pour ordinateur tel que défini par la revendication 10, dans lequel le code de programme de commande comprend :

un code de programme pour faire une interpolation entre l'effet initial et l'effet final pour restituer une pluralité d'images graphiques de sortie.

12. Produit support de programme pour ordinateur tel que défini par la revendication 1, dans lequel l'image d'entrée comprend des champs.

13. Produit support de programme pour ordinateur tel que défini par la revendication 1, dans lequel l'image d'entrée est une pluralité de trames d'une image animée.

14. Appareil pour appliquer des effets à des données graphiques dans un système informatique, le système informatique comportant une unité centrale de traitement (105) et un processeur graphique (167) qui est configuré au préalable pour traiter des données graphiques conformes à un format présélectionné de traitement graphique en 3 D, l'appareil comprenant :

des moyens pour recevoir (202) une image d'entrée, l'image d'entrée étant une représentation en 2 D d'un objet en 3 D ;

des moyens pour définir (200) un effet dans le format présélectionné de traitement graphique en 3 D ;

des moyens pour cartographier l'image d'entrée dans le format présélectionné de traitement graphique en 3 D pour produire une image cartographiée ;

des moyens pour commander (208) pour appliquer l'effet à l'image cartographiée pour produire une image graphique de sortie, l'image graphique de sortie étant le résultat de l'application de l'effet à l'image cartographiée, l'application de l'effet agissant sur la géométrie en 3 D de l'image cartographiée et des textures quelconques associées à l'image cartographiée ; et

des moyens pour convertir (212) l'image graphique de sortie en une représentation en 2 D de l'objet en 3 D pour l'affichage sur un dispositif d'affichage, ladite image de sortie transformée étant le résultat du traitement d'image qui a été appliqué à ladite image d'entrée par l'intermédiaire du traitement graphique 3 D.

15. Appareil tel que défini par la revendication 14, dans lequel le processeur graphique (167) est une carte d'accélérateur graphique.

16. Appareil tel que défini par la revendication 14, dans lequel le format présélectionné de traitement graphique est OPENGL (marque déposée).

17. Appareil tel que défini par la revendicaiton 14, dans lequel les moyens de commande (208) comprennent :

des moyens pour normaliser l'effet par rapport à l'image d'entrée.

18. Appareil tel que défini par la revendication 14, dans lequel l'image d'entrée a une taille, les moyens de commande (208) comprenant :

des moyens pour appliquer l'effet à l'image d'entrée en tant que rapport de la taille de l'image d'entrée.

19. Appareil tel que défini par la revendication 14, dans lequel le système informatique comprend une mémoire, le Produit support de programme pour ordinateur comprenant en outre :

des moyens pour enregistrer l'image graphique de sortie dans la mémoire.

20. Appareil tel que défini par la revendication 14, dans lequel l'image graphique est une trame.

21. Appareil tel que défini par la revendication 14, dans

lequel le processeur graphique (167) comprend une mémoire de texture résidente, les moyens de cartographie comprenant :

des moyens pour enregistrer l'image de cartographie dans la mémoire de texture résidente.

22. Appareil tel que défini par la revendication 14, dans lequel l'effet est défini pour restituer une vue d'un objet texturé en 3 D.

23. Appareil tel que défini par la revendication 14, dans lequel les moyens de définition comprennent :

des moyens pour définir un effet initial et un effet final.

24. Appareil tel que défini par la revendication 23, dans lequel les moyens de commande comprennent :

des moyens pour faire une interpolation entre l'effet initial et l'effet final pour restituer une pluralité d'images graphiques de sortie.

25. Appareil tel que défini par la revendication 14, dans lequel l'image d'entrée comprend des champs.

26. Appareil tel que défini par la revendication 14, dans lequel l'image d'entrée est une pluralité de trames d'une image animée.

27. Procédé pour appliquer des effets à des données graphiques dans un système informatique, le système informatique comportant une unité centrale de traitement (105) et un processeur graphique (167) qui est configuré au préalable pour traiter des données graphiques conformes à un format présélectionné de traitement graphique en 3 D, le procédé comprenant les étapes suivantes :

A. la réception (202) d'une image d'entrée, l'image d'entrée étant une représentation en 2 D d'un objet en 3 D ;
B. la définition (200) d'un effet dans le format présélectionné de traitement graphique en 3 D ;
C. la réalisation d'une cartographie de l'image d'entrée dans le format présélectionné de traitement graphique en 3 D pour produire une image cartographiée ;
D. la commande (208) du processeur graphique pour appliquer l'effet à l'image cartographiée pour produire une image graphique de sortie, l'image graphique de sortie étant le résultat de l'application de l'effet à l'image cartographiée, l'application de l'effet agissant sur la géométrie en 3 D de l'image cartographiée et des textures quelconques associées à l'image cartographiée ; et
E. la conversion (212) de l'image graphique de sortie en une représentation en 2 D de l'objet en 3 D pour l'affichage sur un dispositif d'affichage, ladite image de sortie transformée étant le résultat du traitement d'image qui a été appliqué à ladite image d'entrée par l'intermédiaire du traitement graphique.

28. Procédé tel que défini par la revendication 27, dans lequel le processeur graphique (167) est une carte d'accélérateur graphique.

29. Procédé tel que défini par la revendication 27, dans lequel le format présélectionné de traitement graphique est OPENGL (marque déposée).

30. Procédé tel que défini par la revendication 27, dans lequel le système informatique comprend une unité centrale de traitement (105).

31. Procédé tel que défini par la revendication 27, dans lequel l'étape D comprend l'étape suivante :

D1. normalisation de l'effet par rapport à l'image d'entrée.

32. Procédé tel que défini par la revendication 27, dans lequel l'image d'entrée a une taille, l'étape D comprenant l'étape suivante :

D2. application de l'effet à l'image d'entrée en tant que rapport de la taille de l'image d'entrée.

33. Procédé tel que défini par la revendication 27, dans lequel le système informatique comprend une mémoire, le procédé comprenant en outre l'étape suivante :

F. enregistrement de l'image graphique de sortie dans la mémoire.

34. Procédé tel que défini par la revendication 27, dans lequel l'image graphique est une trame.

35. Procédé tel que défini par la revendication 27, dans lequel le processeur graphique (167) comprend une mémoire de texture résidente, l'étape C comprenant l'étape suivante :

C1. enregistrement de l'image de cartographie dans la mémoire de texture résidente.

36. Procédé tel que défini par la revendication 27, dans lequel l'effet est défini pour restituer une vue d'un objet texturé en 3 D.

37. Procédé tel que défini par la revendication 27, dans

lequel l'étape B comprend l'étape suivante :

B1. définition d'un effet initial et d'un effet final.

38. Procédé tel que défini par la revendication 37, dans lequel l'étape D comprend l'étape suivante :

D3. interpolation entre l'effet initial et l'effet final pour restituer une pluralité d'images graphiques de sortie.

39. Procédé tel que défini par la revendication 27, dans lequel l'image d'entrée comprend des champs.

40. Procédé tel que défini par la revendication 27, dans lequel l'image d'entrée est une pluralité de trames d'une image animée.

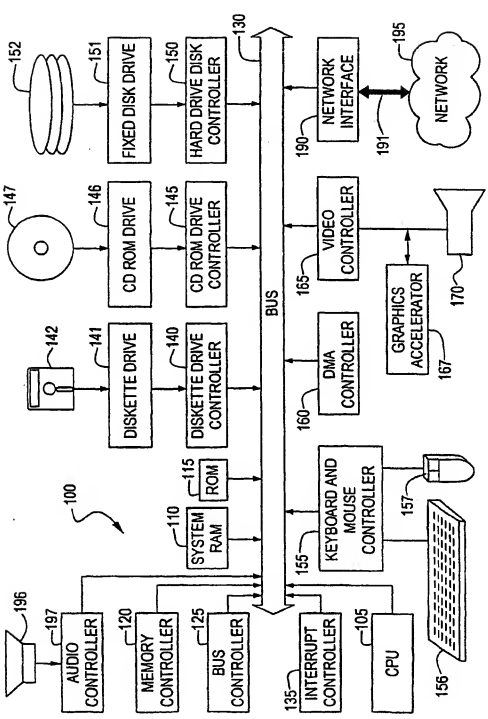
100
105
CPU
110
SYSTEM RAM
115
ROM
120
MEMORY CONTROLLER
125
BUS CONTROLLER
130
BUS
135
INTERRUPT CONTROLLER
140
DISKETTE DRIVE CONTROLLER
141
DISKETTE DRIVE
142
145
CD ROM DRIVE CONTROLLER
146
CD ROM DRIVE
147
150
HARD DRIVE DISK CONTROLLER
151
FIXED DISK DRIVE
152
155
KEYBOARD AND MOUSE CONTROLLER
156
157
160
DMA CONTROLLER
165
VIDEO CONTROLLER
167
GRAPHICS ACCELERATOR
170
190
NETWORK INTERFACE
191
195
NETWORK
196
AUDIO CONTROLLER
197

FIG. 1

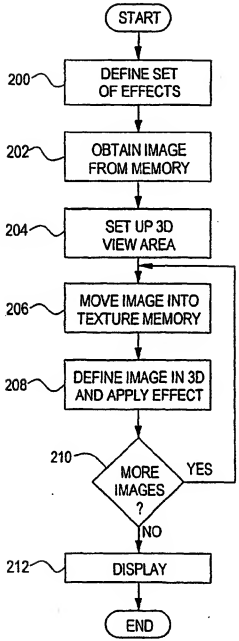
START
200
DEFINE SET OF EFFECTS
202
OBTAIN IMAGE FROM MEMORY
204
SET UP 3D VIEW AREA
206
MOVE IMAGE INTO TEXTURE MEMORY
208
DEFINE IMAGE IN 3D AND APPLY EFFECT
210
MORE IMAGES ?
YES
NO
212
DISPLAY
END

FIG. 2

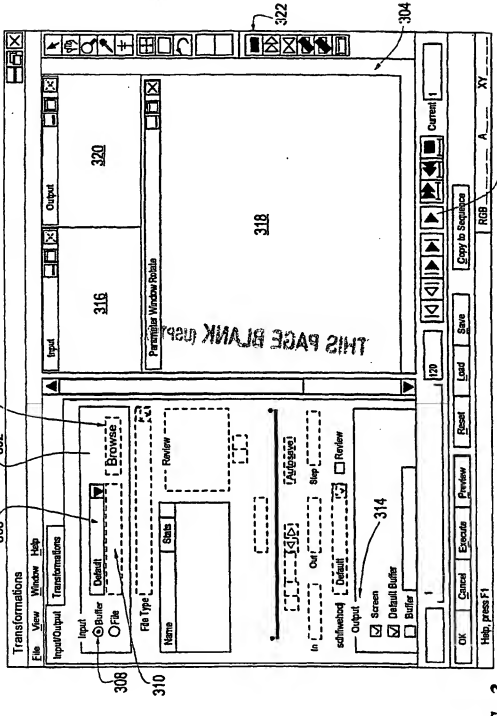
300
302
304
306
308
310
312
314
316
318
320
322
324
Transformations
File View Window Help
Input/Output
Transformations
Input
Buffer
File
Default
Browse...
File Type
Name
Stats
Review
Output
Screen
Default Buffer
Buffer
Default
Review
Input
Output
Permitter Window Points
THIS PAGE BLANK (usp
Load
Save
Copy to Sequence
Current
RGB
OK
Cancel
Execute
Preview
Reset
Help, press F1

FIG. 3